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Genetically modified crops: the truth unveiled

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Abstract

What has long been suspected is true: genetically modified (GM) crops do have real benefits for the environment and for the economic well-being of farmers. A meta-analysis of peer-reviewed journal articles and other literature not published in journals reveals that the adoption of GM crops reduces pesticide input and increases crop yields and farmers' income. The results confirm earlier and smaller studies and therefore are not unexpected. But they are particularly welcome for significantly informing the public debate on GM crops.

Keywords: GM crops, Meta-analysis, Impact, Insect resistance, Herbicide tolerance

Background

Since the market introduction of the genetically modified FLAVR SAVR tomato in 1994 [1] and the successful sales of transparently labeled GM tomato paste by Safeway and Sainsbury supermarket chains from 1996 to 1999, GM crops and food have become the center of public controversy [2]. Although FLAVR SAVR and the tomato paste have vanished from the supermarket shelves, in 2013, GM crops were grown on more than 175 million hectares globally, by millions of farmers [3], many of them in developing countries. However, this has not helped to build broad trust in the safety and environmental as well as the economic benefits of the fastest technology ever adopted by farmers in the history of agriculture [4]. Despite numerous peer-reviewed scientific studies showing that GM crops and food are safe for the consumer and the environment [5-7], the exchange of words continues, often with unsubstantiated and misleading claims by nongovernmental organizations whose incomes rely on fueling public skepticism. Nevertheless, after a large-scale study that found no impact of GM feedstuffs on livestock populations [8], John Entine in the magazine Forbes recently declared 'The debate about GMO safety is over' [9]. But is the GM crop debate over? While this may be true among scientists, arguments persist in public debates that GM crops are harming the environment and hurting farmers economically, especially in developing countries. The reason for these lingering perceptions, especially in Europe, is that a large-scale statistical and scientific assessment (meta-analysis) of the literature to provide the necessary factual information on the impacts of GM crops in agricultural production was missing.

Commentary

A recent meta-analysis by Matin Qaim, professor of Food Economics and Rural Development, and his colleague Wilhelm Klümper [10] of all the relevant literature since 1995 now fills this gap. The authors found that, on average, production of GM crops reduced chemical pesticide input by 37%, increased crop yields by 22%, and increased farmers' profits by 68%. These numbers are significant and compelling considering that the accumulated land area planted with GM crops during the last 18 years represents an agricultural production area of more than 150% of the size of countries such as the USA or China [3]. The positive impact of GM crop adoption on yield is especially encouraging because this means that GM crops can produce more on less land. In summary, the aggregate literature reveals conclusively that there are considerable benefits of GM crop adoption for both the environment and for the economic well-being of farmers - facts that are often misrepresented in the public debate.

Why can this study be trusted? The authors focused on herbicide-tolerant and insect-resistant crops (maize, soybean, cotton) for which a large number of original peer-reviewed impact study reports were already available and that have also been discussed widely in the non-peer reviewed literature. They searched not only in the ISI Web of Knowledge and Google Scholar for their analysis but also used the EconLit and AgEcon Search

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databases because their contents are tailored to economic studies. The keyword search was unbiased and designed to retrieve peer-reviewed and gray literature reporting both positive and negative impacts. This approach was different from previous reviews of GM crop impact that were limited to peer-reviewed literature only and therefore may be been skewed toward positive results. It is often studies without such peer review, for example, [11], however, that influence the public debate and therefore detract from fact-based decision-making processes.

When dealing with a large dataset on GM crop literature, effect sizes and influencing factors are important considerations because they allow a quantification of the extent of GM crop impact rather than estimating only whether or not an impact was observed. Supported, as they are, by rigorous statistics, the results of the meta-analysis reported by Klümper and Qaim [10] convincingly show that average agronomic and economic benefits of GM crop production are significant and sizeable. Although the review was limited to insect-resistant and herbicide-tolerant maize, soybean, and cotton, the impacts are likely to be similar for canola and sugar beet, which are now grown on large acreages as well. There was no evidence that studies funded by industry had any influence on impact estimates. Studies reported in the peer-reviewed journals trended toward a higher yield impact of GM crops than the average resulting from the meta-analysis [10]. This is perhaps not unexpected because non-reviewed (gray) literature published by nongovernmental organizations that was included in the meta-analysis typically has a negative bias.

With the facts on the table, will this end the GM crop debate? Probably not, because the reported pesticide inputs were lower and yield gains were higher for insect-resistant crops than herbicide-tolerant crops, which have been criticized for their large-scale monoculture production, increased herbicide use, and the spread of herbicide-resistant weeds. This will continue to fuel the debate because the use of GM crops is often a synonym for the way we grow crops, although one does not necessitate the other. Large-scale and chemical-intensive monoculture production is also found for non-GM crops, but this is conveniently ignored by GMO opponents in the debate on GM crops. Changing agriculture to sustainable production does not exclude GM crops because insect- and pathogen-resistant GM crops would also be useful and beneficial in integrated and organic agriculture to reduce pesticide inputs.

Conclusion

The meta-analysis of the impacts of GM crops provides welcome new facts that cannot be ignored. The results confirm and extend earlier and smaller studies that already reported benefits of GM crops based on existing farm-level impact data for GM crops, for example, [12,13] or focusing on small-holder farming households in selected countries [14]. One can only hope that the collective evidence for the beneficial impacts of GM crops will now enable a more informed and rational debate. Even if opposition and false claims continue to spur public skepticism, farmers must be allowed to choose and grow the crops - GM or non-GM - that improve their economic situation and help them to contribute to global food security.

Competing interests
The author has no competing interest in the meta-analysis reported by the authors. No payment was sought or received for writing the commentary.

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